# MethodSCRIPT SDK Example - C

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## 1.1 Contents:

The example “MethodScriptExample.c” found in the “/MethodScriptExample-C” folder demonstrates basic communication with the EmStat Pico using the SDK (C libraries). The example allows the user to start measurements on the EmStat Pico from the PC using a simple C program which makes use of the MethodSCRIPT SDK (C libraries).

### 1.1.1 Basic Console Example (MethodScriptExample.c)

This example demonstrates how to implement serial communication with the EmStat Pico to

- Establish a connection with the device
- Write the input measurement parameters to the device
- Read and parse the measurement response from the device

This does not include error handling, method validation etc.

## 1.2 Communications

The MSComm.c from the MethodSCRIPT SDK (C libraries) acts as the communication object to read/write from/to the EmStat Pico. So the SDK found in the /MethodScriptComm has to be included in the C program as below.

```
#include "MethodScriptComm/MSComm.h"
```

The MSComm is then initialized with the read/write functions as in the code below.

```
MSComm msComm;
RetCode code = MSCommInit(&msComm, &WriteToDevice, &ReadFromDevice);
```

The read/write functions in the C program are mapped to the msComm as shown in the code below.

```
msComm->writeCharFunc = writeCharFunc;
msComm->readCharFunc = readCharFunc;
```

The necessary read/write functions are defined in the C program as below.

```
int WriteToDevice(char c)
{
	char writeChar[2] = {c,'\0'};
	if (WriteFile(hCom, writeChar, 1, &dwBytesWritten, NULL))
	{
		return 1;
	}
	return 0;
}

int ReadFromDevice()
{
	char tempChar;				//Temporary character used for reading
	DWORD noBytesRead;
	ReadFile(hCom,					//Handle of the Serial port
	         &tempChar,				//Temporary character
	         sizeof(tempChar),		//Size of TempChar
	         &noBytesRead,			//Number of bytes read
	         NULL);
	return (int)tempChar;
}
```

### 1.2.1 Connecting to the device

The following code snippet shows how to open a serial com port using the Windows API . Inorder to use the Windows API for serial communication, the windows.h header has to be included in the C program's header file as below.

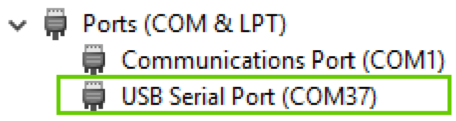
```
#include <windows.h>
```

The code below can be used to open the com port connected to the devic.

```
HANDLE hCom;
hCom = CreateFile(PORT_NAME, GENERIC_READ | GENERIC_WRITE, 0,  // must be
opened with exclusive-access
              NULL,                      // no security attributes
              OPEN_EXISTING,           // must use OPEN_EXISTING
              0,                       // not overlapped I/O
              NULL              // hTemplate must be NULL for comm devices
              );
```

```
const char* PORT_NAME = "\\\\.\\COM37";
```

The name of the com port connected to the device can be found in the Device Manager in Control Panel in Windows as shown below.



Ports (COM & LPT)
Communications Port (COM1)
USB Serial Port (COM37)

### 1.2.2 Sending the method script

The measurement configuration parameters can be read from a script file stored in the PC. In this example, the script file is stored in the same directory as the application executable.

### 1.2.3 Receiving response

The code to receive and parse the response from the device goes on continuously until the measurement response ends. Inorder to read and parse the response from the device, the Receive Package function from the MSComm library can be used.

```
code = ReceivePackage(&msComm, &data);
```

The ReceivePackage() function in the C library (MSComm.c) reads character by character until end of line ('\n') from the device using the msComm read wrapper - readCharFunc

### 1.2.4 Parsing the response

Each line of response returned by the function **`ReadBuf`**`() in MSComm library`, can be further parsed if it is identified to be a data package. Here's a sample response (raw data) from a Linear sweep voltammetric measurement.

```
eM0000\n
Pda7F85F3Fu;ba48D503Dp,10,288\n
Pda7F9234Bu;ba4E2C324p,10,288\n
Pda806EC24u;baAE16C6Dp,10,288\n
Pda807B031u;baB360495p,10,288\n
*\n
\n
```

While parsing the response, various identifiers are used to identify the type of response packages. For example, In the above sample response package,

1. 'e' marks the beginning of a response.
2. 'M' marks the beginning of a measurement loop.
3. 'P' marks the beginning of a row of data package.
4. "*\n" marks the end of a measurement loop.
5. "\n" marks the end of response.

The following information can be found in the data packages received from the device.

- Potential (set cell potential in V)
- Current (measured current in A)

In case of Impedance spectroscopy measurements, the following data values can be obtained from the response.

- Frequency (set frequency in Hz)
- Real part of complex Impedance (measured impedance Ohm)
- Imaginary part of complex Impedance (measured impedance in Ohm)

The following meta data values if present can also be obtained from the data packages.

- CurrentStatus (OK, underload, overload, overload warning)
- CurrentRange (the current range in use at the moment)
- Noise (Noise)

### 1.2.4.1 Parsing the parameter values

Each row of data package begins with the header 'P'. The parameters from the data package line can be then split in to tokens based on the delimiter ';'. Each of the parameters separated from the package line can be then parsed to get the actual values of the parameters.

The initial two characters of every parameter identifies the parameter.

```
strncpy(paramIdentifier, param, 2); //Splits the parameter identifier string
```

The potential readings are identified by the string "da"
The current readings are identified by the string "ba"
The frequency readings are identified by the string "dc"
The real impedance readings are identified by the string "cc"
The imaginary impedance readings are identified by the string "cd"

For example, in the sample package seen above, the parameter identifiers are
'da7F85F3Fu' - 'da' Potential reading and
'ba48D503Dp,10,288' – 'ba' current reading.

The following 8 characters hold the parameter value

The parameter value for current reading (8 characters) from the above sample package is '48D503Dp'.

This value is further parsed to retrieve the actual parameter value with the respective unit prefix.

```
//Retrieves the actual parameter value
parameterValue = (float)GetParameterValue(paramValue);
```

The SI unit prefix from the package can be obtained from the parameter value at position 8

```
//Identify the SI unit prefix from the package at position 8
char charUnitPrefix = paramValue[7];
```

In the above sample package, the unit prefix for current data is ‘p’ which is 1e-12 A.

After obtaining the parameter identifier and the parameter values from the package, the meta data values if present can be parsed. Meta data values if present are separated by the demiliter character ‘,’.

```
//Rest of the parameter is further parsed to get meta data values
ParseMetaDataValues(param + 10, retData);
```

#### 1.2.4.2 Parsing the meta data values

The meta data values are separated based on the delimiter ‘,’ and each of the values is further parsed to get the actual value.

The first character of each meta data value metaData[0] identifies the type of meta data.

‘1’ – status
‘2’ – Current range index
‘4’ - Noise

The status is 1 character hex bit mask. It is converted to long int. The status can be obtained as shown in the code snippet below.

```
char *ptr;
long statusBits = strtol(&metaDataStatus[1], &ptr , 16);
```

For example, in the above sample, the available meta data values for current data are,
10,288. The first meta data value is 10.

1 – meta data status – 0 indicates OK.

The meta data type current range is 2 characters long hex value. **If the fi**rst bit high (0x80) it indicates a high speed mode current range.

The code below can be used to get current range bits from the package.

```
char  crBytePackage[3];
char* ptr;
//Fetches the current range bits from the package
strncpy(crBytePackage, metaDataCR+1, 2);

The hex value is then converted to int to get the current range string as
shown below.

char* currentRangeStr;
int crByte = strtol(crBytePackage, &ptr, 16);
```

For example, in the above sample, the second meta data available is 288.

2 – indicates the type – current range
88 – indicates the hex value for current range index – 1mA. The first bit 8 implies that it is high speed mode current range.